955,497

PATENT SPECIFICATION

NO DRAWINGS

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Date of Application and filing Complete Specification Feb. 16, 1962.
No. 6161/62.
Application made in France (No. 855,625) on March 14, 1961.
Complete Specification Published April 15, 1964.

The inventor of this invention in the sense of being the actual deviser thereof within the meaning of Section 16 of the Patents Act 1949 is Jean Torrilhon, a citizen of France, of 20 Place Malesherbes, Paris. France.

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COMPLETE SPECIFICATION

Improved Reinforced Plastic Products and Processes for their Production

ERRATUM

SPECIFICATION No. 955,497

Page 3, line 34, *for* "mould, release" *read* "mould-release"

THE PATENT OFFICE
3rd September 1964

felts consisting of jute or flax, the products are porous and have poor mechanical properties and poor resistance to weather in spite of the heat and pressure used in the moulding press. Furthermore, when they are cut up, it is observed that they have a pasteboard-like texture which is an obvious sign of a poor bond between the fibres and the resin.

Moreover, when other liquid resins, such as phenol-formaldehyde varnishes or syrups are used in conjunction with these same flax or jute felts, it is extremely difficult to impregnate the fibres completely and to dry them to the desired degree before moulding, and the quality of the products obtained is scarcely any better than that of the products produced from polyester resins.

The invention is concerned with a process [illegible] taken to completion.

In one method of carrying out the invention, a fleece of jute or flax fibres is produced by means of a machine known under the name of a "condenser fleecing machine" or "nappeuse à condenseur" (such machines produce the textile fibres, previously cut to a specific length, in an extremely regular fleece which exhibits substantially no natural stratification). This fleece is then formed into a felt by a needling process and the felt is cut into workpieces having a shape corresponding with that of the product which it is desired to obtain.

One of these workpieces is then sprinkled with a uniform layer of incompletely condensed phenol-formaldehyde resin and then covered with a second identical workpiece.

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COMPLETE SPECIFICATION

Improved Reinforced Plastic Products and Processes for their Production

We, COMPTOIR LINIER, a French body corporate of 20 Place Malesherbes, Paris, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THIS INVENTION relates to new reinforced moulded plastic products and to methods of producing the same.

Moulded products have already been produced from plastic material reinforced with glass fibres or synthetic fibres, but attempts to apply the same manufacturing processes while using natural fibres give products which do not have qualities comparable to those of products reinforced with glass fibres or synthetic fibres.

Thus, when polyester resins (which are commonly employed for the production of moulded products reinforced with mats of glass fibres) are used in conjunction with needle-felts consisting of jute or flax, the products are porous and have poor mechanical properties and poor resistance to weather in spite of the heat and pressure used in the moulding press. Furthermore, when they are cut up, it is observed that they have a pasteboard-like texture which is an obvious sign of a poor bond between the fibres and the resin.

Moreover, when other liquid resins, such as phenol-formaldehyde varnishes or syrups are used in conjunction with these same flax or jute felts, it is extremely difficult to impregnate the fibres completely and to dry them to the desired degree before moulding, and the quality of the products obtained is scarcely any better than that of the products produced from polyester resins.

The invention is concerned with a process whereby it is possible to obtain products of moulded plastic material reinforced with natural fibres which have qualities very much superior to those of products which are obtained by simply substituting natural fibres for glass fibres or synthetic fibres in the processes used hitherto.

The process of the present invention is essentially characterised in that a moulding operation with the use of pressure and heat is carried out on a fleece or felt consisting predominantly of jute or flax fibres in which an incompletely condensed phenol-formaldehyde resin, especially of the "Novolac" type, has been uniformly distributed in powdered form. The word "Novolac" is a Registered Trade Mark and is used for incompletely condensed phenol-aldehyde resins formed with less than 1 mole of formaldehyde per mole of phenol and requiring the addition of further formaldehyde, e.g. in the form of hexamethylene tetramine, to enable the condensation to be taken to completion.

In one method of carrying out the invention, a fleece of jute or flax fibres is produced by means of a machine known under the name of a "condenser fleecing machine" or "nappeuse à condenseur" (such machines produce the textile fibres, previously cut to a specific length, in an extremely regular fleece which exhibits substantially no natural stratification). This fleece is then formed into a felt by a needling process and the felt is cut into workpieces having a shape corresponding with that of the product which it is desired to obtain.

One of these workpieces is then sprinkled with a uniform layer of incompletely condensed phenol-formaldehyde resin and then covered with a second identical workpiece.

After this, the two superposed workpieces are placed in a press which is slightly heated so as to cause the fusion of the resin (without however starting its further polymerisation), which makes it possible for the said resin to be distributed uniformly throughout the thickness of the felt.

After this operation, the whole can be moulded, either in the same press or in another, by subjecting it to heat (at polymerisation temperature) and pressure.

Alternatively, a uniform fleece of jute or flax fibres is likewise first of all produced on a "condenser fleecing machine", and then upon issuing from this machine the fleece (which is in the form of a dense carpet of fibres which are positioned almost vertically) is sprinkled with the incompletely condensed phenol-formaldehyde resin in powdered form. Then the fleece is subjected to a needling process which interlocks the fibres with one another and with the powder, thus producing a felt constituted by a very uniform mixture of flax or jute fibres impregnated with powdered resin.

All that has to be done then is to cut out some workpieces from the felt which has been impregnated in this way, and to mould them in the heating press. If necessary, it may be desirable in some cases to carry out a preliminary heating operation before moulding the workpieces, similar to that used in the first mode of carrying this process into effect.

The invention also includes the moulded products so obtained which are essentially phenol-formaldehyde moulded products reinforced by jute or flax fibres.

Preferably the powdered resins already contain hexamethylene tetramine or like hardener. It is also advantageous to operate in the presence of an excess of free phenol which acts as a solvent and as a wetting agent.

The fact that according to the present invention phenol-formaldehyde resins are used in powder form instead of liquid phenol-formaldehyde resins or polyesters, leads directly to considerable advantages as regards ease of handling and storage and also as regards greater cleanness in the workshops. But it also makes it possible to obtain products of a quality which cannot be obtained by using the resins in liquid form.

This superiority obtained by using powdered phenol-formaldehyde resins may be due to the fact that the resins do not contain any substantial amount of solvent or humidity, thus avoiding any vaporization or blistering of the composition during the hot polymerisation in the press, or may be due to the powdered resins undergoing only a slight flow during the moulding operation thus giving an improved enveloping of the fibres, whereas phenol-formaldehyde syrups and polyesters pass, during moulding, through a phase where they are extremely fluid and therefore tend to run off the felt which is to reinforce the end product.

Possibly, owing to the fact that the resins in the process used according to the present invention do not pass through an extremely fluid phase, the pressure in the moulding press brings about some kind of chemical bonding between the cellulose of the fibres and the diphenyl methane molecules of the resin. There appears to be some definite co-action between the phenol-formaldehyde resins and the jute or flax fibres used according to the invention, since, if the same resins and the same process are applied to glass fibres or to synthetic fibres, it is found the resins do not attach themselves to these smooth fibres and hence it is very difficult, whatever precautions are taken, to obtain a good distribution of the resins throughout the mass of the felt.

In accordance with the invention, a certain proportion of sisal fibres or other fibres, such as doum or esparto, may be mixed with the jute and flax fibres, thus enabling the cost of the finished product to be reduced. In this case, the powder remains sufficiently attached to the jute or flax fibres to obtain the necessary uniformity.

Furthermore, powdered mineral fillers such as fossil silica or vegetable fillers such as powdered cork may be mixed with the powdered resin, which permits modification both of the density and of the cost of the products obtained.

The invention is illustrated by the following Examples.

EXAMPLE I

Raw jute from its original bales and having a humidity of 15 to 18% is chopped to a length of 2 to 5 cm. on a reciprocating or rotary chopper. Following this, the fibres are passed through a drying drum which brings their humidity to about 4 to 6%, and are then introduced into a "condenser fleecing machine" which produces a very regular fleece about 10 cm. in thickness and weighing 1,300 g/m^2, the fibres being situated in an almost vertical position in the fleece.

As it comes from the fleecing machine, the fleece is sprinkled by means of a vibrating sprinkler with 900 g/m^2 of powdered incompletely condensed phenol-formaldehyde resin of fleece, and then the fleece is converted to the form of a needle-felt, impregnated with powdered resin, which is then cut up into workpieces of appropriate size which are moulded in a heated press so as to obtain the final product by completing the polymerisation of the resin.

EXAMPLE II

A needle-felt consisting of jute weighing 650 g/m^2 and obtained from pure fibres of good quality is cut up into workpieces the size of which corresponds to that of the desired products. These workpieces are stoved so as

to bring their humidity to about 4 to 6%. Then one out of every two workpieces is passed below a sprinkler which covers it with a powdered incompleted condensed phenol-formaldehyde resin at the rate of 900 g. of powder per m² of felt. A second, non-sprinkled workpiece is placed on the first workpiece which has thus been covered with powdered resin, and the sandwich obtained is introduced into a press, heated to 80° C. and exerting a pressure of about 25 kg/cm², and kept there for 2 minutes. The sandwich thus treated is then placed in the moulding press which has a polished and chromium-plated mould of the semi-positive type (that is to say, a mould wherein the two parts approach one another until a volume corresponding exactly to the form of the piece to be produced is obtained). This mould which is heated to 130° C., exerts a pressure of about 50 kg/cm² and gives a finished product after a heating time of 2 minutes.

The products produced in accordance with these two examples are in the form of rigid pieces having a thickness of 1.7 to 1.8 mm, a density of 1.25 to 1.30 and a bending strength of 1,800 to 2,200 kg/cm².

The phenol-formaldehyde resin powder used in the two examples is that sold under the Registered Trade Mark "Novolac". This powder contains from 10 to 12% of a hardener which is generally constituted by hexamethylene tetramine and 1 to 2% of a mould, release agent, generally zinc stearate.

The pre-heating press and the moulding press can be heated by electrical resistances or by the circulation of a hot fluid through a duct in the mould (this gives more uniform heating), or by high-frequency heating between the two parts of the mould, which propagates the heat in a particularly uniform manner and which is made possible by reason of the fact that the powdered phenol-formaldehyde resins do not flow readily.

WHAT WE CLAIM IS:—

1. Process for the production of an improved reinforced moulded plastic product, comprising distributing a powdered incompletely condensed phenol-formaldehyde resin within a fleece or felt consisting predominantly of jute or flax fibres and moulding under heat and pressure to the required shape while completing the condensation of the resin.

2. Process according to Claim 1 wherein the powdered resin is an incompletely condensed phenol-aldehyde resin formed with less than 1 mol of formaldehyde per mol of phenol and is mixed with hexamethylene tetramine or like hardening agent.

3. Process according to Claim 1 or 2, wherein a layer of the powdered resin is positioned between 2 layers of felt each of which has been produced by needling of a fleece of the type in which the fibres are vertically arranged.

4. Process according to Claim 1 or 2, wherein a fleece of the type in which the fibres are arranged vertically is sprinkled with the powdered resin and is thereafter needled to produce a felt with the resin distributed therein.

5. Process according to any of the preceding claims, wherein uniform distribution of the resin is assisted by subjecting the fibre-resin assembly to heat so as to melt the resin without finally hardening it.

6. Process according to claims 5, wherein a temperature of about 80° C. is used.

7. Process for the production of improved reinforced phenol-formaldehyde moulded products, substantially as described in the Examples.

8. Reinforced phenol-formaldehyde moulded products, obtained by any of the processes claimed in any of claims 1—7.

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